

## PRINTER TO AVOID UNNECESSARY PRINTING

BACKGROUND OF THE INVENTIONField of the Invention

- 5           This invention relates to a printer to avoid an unnecessary printing even when a printer cable is removed during a printing operation.

Description of the Related Art

- 10           A printer cable like a parallel cable and a USB (Universal Serial Bus) cable connects a printer and a computer. Then, via the printer cable, printing data and so on is transmitted from the computer to the printer, and status information and so on is transmitted from the printer to the computer.

- 15           When the printer cable like the parallel cable and the USB cable is removed during the printer's printing operation, the printing data is not transmitted from the computer to the printer, and the printing operation is stopped. Such as action as removing cable is made by intentionally, carelessly and so on. For example,  
20           the user removes the cable intentionally in the case where the computer connecting to this printer is changed to another one.

- When the cable is removed during the printer's printing operation, the printing operation after the printer cable is removed is not done even if the printer cable is plugged again  
25           in the printer thereafter. Moreover, there is a possibility that the printing data transmitted before the printer cable is removed remains in a data buffer of the printer. In this case, there is a possibility that the printer prints meaninglessly. That is, a possibility of performing the so-called garbage printing  
30           remains.

          In these cases, the user erases the printing data which remains in the data buffer by turning off a power switch of the printer or by operating a control panel of the printer in the conventional printer.

- 35           Recently, a printer having neither a power switch nor a control panel for reducing the costs appears on the market. For this printer, the user has to remove and plug again a power cable

of the printer for erasing the printing data stored in the printer buffer. However, it is troublesome for the user to remove and plug again the power cable for erasing the printing data in the data buffer.

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#### SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a printer which is configured not to perform an unnecessary printing operation when a printer cable, which connects a printer and a  
10 computer, is unplugged during a printing operation.

In order to accomplish the aforementioned and other objects, according to one aspect of the present invention, a printer comprising:

a detector configured to detect that a printer cable, which  
15 is connected to a computer, is unplugged; and

a clearer configured to clear printing data received from the computer and stored in a data buffer when the detector detects that the printer cable has been unplugged.

According to another aspect of the present invention, a  
20 printer comprising:

a print start detector configured to detect that a print start signal, which indicates a start of a transmission of printing data, is received from a computer;

a data buffer configured to temporary store the printing  
25 data received from the computer;

a print finish detector configured to detect that a print finish signal, which indicates a finish of the transmission of the printing data, is received from the computer; and

a clearer configured to clear the printing data stored in  
30 the data buffer when the print start signal is received again from the computer or another computer after the print start detector has detected the print start signal and before the print finish detector detects the print finish signal.

According to a further aspect of the present invention,  
35 a printer comprising:

a cable detector configured to detect whether a printer cable, which is connected to a computer, is plugged normally or

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not;

a data buffer configured to temporary store printing data received from the computer; and

5 a clearer configured to clear the printing data stored in the data buffer when the cable detector detects that the printer cable has been unplugged.

Additionally, the invention can be realized as a control method of a printer. Furthermore, it is possible to realize the invention as a program for controlling the printer in this manner,  
10 a recording medium storing a program therefor, or a program data signal embodied in a carrier wave therefor.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram showing a hardware configuration of a printing system according to an embodiment of the invention;  
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Fig. 2 is a diagram which illustrates a signal transmitting and receiving relationship between a computer and a printer in the printing system shown in Fig. 1 when a printing is normally performed;

20 Fig. 3 is a diagram which illustrates a signal transmitting and receiving relationship between the computer and the printer in a first embodiment of the invention when a printer cable is removed in a printing operation;

Fig. 4 is a diagram showing a flow chart for explaining a printing data receiving process in the printer according to  
25 the first embodiment of the invention;

Fig. 5 is a diagram showing a flow chart for explaining a printing data receiving process according to a second embodiment of the invention;

30 Fig. 6 is a diagram showing a flow chart for explaining a printing data receiving process according to a third embodiment of the invention;

Fig. 7 is a diagram showing a logical channel structure established between the printer and the computer according to  
35 a fourth embodiment of the invention;

Fig. 8 is a timing chart for explaining packets transmitted and received in a control channel and a printing data transferring

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channel, which are established between the printer and the computer, and a status of an observation effective flag according to the fourth embodiment of the invention;

Fig. 9 is a timing chart for explaining packets transmitted and received in a control channel and a printing data transferring channel, which are established between the printer and the computer, and a status of a packet receiving flag according to the fourth embodiment of the invention;

Fig. 10 is a diagram for explaining signals transmitted and received between the printer and the computer according to the fourth embodiment of the invention;

Fig. 11 is a diagram showing a flow chart for explaining a printing data transmitting process, which is executed by the computer according to the fourth embodiment of the invention;

Fig. 12 is a diagram showing a flow chart for explaining a receiving process, which is executed by the printer according to the fourth embodiment of the invention;

Fig. 13 is a diagram showing a flow chart for explaining a removing and plugging detecting process and a reset process according to the fourth embodiment of the invention; and

Fig. 14 is a diagram showing a flow chart for explaining a removing and plugging detecting process and a reset process according to the fifth embodiment of the invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

### (First Embodiment)

According to the first embodiment of the invention, in a printing system in which a parallel cable connects a printer and a computer, the printer is configured to erase printing data in a data buffer thereof when the parallel cable is removed and then plugged again during printing operation. More detailed explanation is made below.

Fig. 1 is a diagram showing a hardware configuration of a printing system according to an embodiment of the invention. As shown in Fig. 1, the printing system according to the embodiment of the invention has a printer 10 and a computer 30.

The printer 10 has a CPU 12, a RAM 14, a ROM 16 and interfaces 18 and 20, and they are connected to each other via an internal bus. Furthermore, the internal bus is connected to a printing executing section 22 via the interface 20. In this embodiment, the printer 10 is an ink jet printer, and a printing is performed in the printing executing section 22 by driving an ink head. In addition, the printer 10 has a power cord 24, and an electric power is supplied to the printer 10 by plugging the power cord 24 in a receptacle. However, the printer 10 does not have a power switch and does not have a control panel.

The computer 30 has a CPU 32, a RAM 34, a ROM 36 and interfaces 38 and 40, and they are connected to each other via an internal bus. Furthermore, the internal bus is connected to a hard disk 42 via the interface 40.

A printer cable 50 connects the printer 10 and the computer 30. In this embodiment, the printer cable 50 is a parallel cable in conformity with the IEEE 1284.4 standard. At one end of the printer cable 50, a connector 52 is provided, which is inserted into a connecting portion 54 of the printer 10. At the other end of the printer cable 50, a connector 56 is provided, which is inserted into a connecting portion 58 of the computer 30. A user can arbitrarily insert the connectors 52, 56 of the printer cable into the connecting portions 54, 58 and remove them therefrom. The connecting portion 54 of the printer 10 is connected to the interface 18, and the connecting portion 58 of the computer 30 is connected to the interface 38.

Next, an explanation is made about an example of the printing operation according to the printing system shown in Fig. 1. For example, printing data stored in the hard disk 42 of the computer 30 is transmitted from the connecting portion 58 to the printer cable 50 via the interface 38. The printing data transmitted to the printer cable 50 is stored in RAM 14 of the printer 10 via the connecting portion 54 and the interface 18. That is, at least a portion of the RAM 14 constitutes a data buffer for the printing data according to this embodiment.

The printer 10 performs a necessary data conversion to the printing data stored in the RAM 14, and print it in the printing

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Next, the computer 30 sends a magic string MS. Then, the

computer 30 starts sending printing data PDAT. In one example of Fig. 3, it is assumed that the printer cable 50 is removed from the printer 10 or the computer 30 by any reason or any cause. After that, it is assumed that the printer cable 50 is plugged into the printer 10 or the computer 30. In this case, another computer, which is different from the computer 30, may be connected to the printer 10. In such a case, there is a possibility that a part of the printing data PDAT, which is received until the printer cable 50 is removed, remains in the data buffer of the printer 10.

When the user tries to print next, as mentioned above, the computer 30 transmits a device ID request DREQ to the printer 10. That is, in this embodiment, the computer 30 is designed to send the device ID request DREQ to the printer 10. Therefore, The printer 10, which receives the device ID request DREQ, is able to judge that the printing data PDAT stored in the RAM 14 is unnecessary. As a result, the printer 10 erases the remaining printing data PDAT in the RAM 14. Furthermore, the printer 10 makes a necessary initial setting of the interface and the like.

Next, referring to Fig. 4, a printing data receiving processing of the printer 10 is explained in detail. Fig. 4 is a flow chart for explaining the printing data receiving processing.

A program for the printing data receiving processing is stored in the ROM 16 of the printer 10. The power is supplied to the printer 10, and the CPU 12 reads out and runs this program so that the printing data receiving processing is performed.

First, as shown in Fig. 4, the printer 10 judges whether a magic string MS has been received (step S10). When the magic string MS has not yet been received (step S10: No), the printer 10 is waiting by repeating step 10. Not receiving the magic string MS means that printing does not start.

When the printer 10 receives the magic string MS (step S10: Yes), the printer 10 judges whether a device ID request DREQ has been received (step S11). Receiving the magic string MS means that printing does start. Therefore, it is possible for the printer 10, which receives the device ID request DREQ, to presume on the basis of receiving the device ID request that a new print starts

again after the printer cable is unplugged once in printing and then plugged again. Therefore, when the printer 10 receives the device ID request DREQ (step S11: Yes), the printer 10 clears the rest of the printing data PDAT in the RAM 14 which is the data buffer, ejects paper which is stopped in partway for printing, and initializes the interface (step S12).

When the printer 10 does not receive the device ID request DREQ (step S11: No), the printer 10 judges whether a close channel CC has been received (step S13). When the printer 10 does not receive the close channel CC (step S13: No), it means that the printing operation is under way so that the printer 10 does print (step S14). Then, it repeats the process from step S11 explained above.

On the other hand, when the printer 10 receives the close channel CC (step S13: Yes), it means that the printing has finished so that the printer 10 repeats the process from step S10 explained above.

As explained above, the printing system according to this embodiment can avoid an unnecessary print when the printer cable 50 is unplugged under printing, even if the printer cable 50 is a parallel cable that is not able to directly detect it unplugging. In more detail, when the printer cable 50 is removed while the printer 10 is printing, the user inserts the printer cable 50 into the printer 10 again, and begins to newly print after a lapse of a predetermined time. At the beginning of the print, in this embodiment, the printing system has an arrangement that the device ID request DREQ is transmitted from the computer 30 to the printer 10. Therefore, in this embodiment, when the printer 10 receives the device ID request DREQ which means starting a print before receiving the close channel CC which means ending a print, the printer 10 presumes that the printer cable 50 is unplugged once and then plugged once more and clears the rest of the printing data PDAT in the RAM 14. As a result, it prevents the printer 10 from printing the unnecessary printing data PDAT remaining in the RAM 14 and performing meaningless printing.

In addition, in the printer 10 which has neither a power switch nor a control panel, the rest of the printing data PDAT



remaining in the RAM 14 can be cleared without unplugging and plugging the power cord 24. Therefore, the ease-of-use of the printer 10 can be improved.

(Second Embodiment)

5 According to the second embodiment of the invention, in a printing system which has a USB cable connecting a printer and a computer, when the USB cable is unplugged from the printer during a printing operation and then plugged into the printer, the printer erases the printing data in a data buffer. More detailed  
10 explanation is made below.

The hardware configuration of the printing system according to the second embodiment of the invention is similar to the printing system shown in Fig. 1, but the printer cable 50, which connects the printer 10 and the computer 30, is a USB cable. This point  
15 is different from the first embodiment.

Referring to Fig. 5, a printing data receiving processing of the printer 10 is explained in detail. Fig. 5 is a flow chart for explaining the printing data receiving processing of the printer 10.

20 A program for the printing data receiving processing is stored in the ROM 16 of the printer 10. The power is supplied to the printer 10, and the CPU 12 reads out and runs this program so that the printing data receiving processing is performed.

First as shown in Fig. 5, the printer 10 reads a voltage on a VBUS (a power source bus) of the USB (step S20). Concerning  
25 the USB cable, when the printer cable 50 is connected normally, the VBUS of the printer cable 50 is supplied with 5V. Therefore, the printer 10 can judge whether the printer cable 50 is connected normally by detecting the voltage of the VBUS and whether it is  
30 approximately 5V or approximately 0V.

Hence, the printer 10 judges whether the voltage is approximately 5V (step S21). When the voltage has been about 5V (step S21: Yes), the process of the above-mentioned step S20 is repeated since the printer cable 50 is connected properly. On  
35 the other hand, when the voltage has not been about 5V (step S21: No), for instance, when the voltage has dropped about 0V, the printer 10 clears the RAM 14 which is the data buffer since the

printer cable 50 is removed.

Subsequently, the printer 10 reads again a voltage on the VBUS of the USB cable (step S23). Then, the printer 10 judges whether the voltage has been about 5V (step S24). When the voltage of the VBUS has not been about 5V (step S24: No), the process of the above-mentioned steps S23 and S24 are repeated for waiting. On the other hand, when the voltage has been about 5V (step S24: Yes), the printer 10 initializes the interface and so on for next printing since the printer cable 50 is reinserted. Then, the printer 10 repeats the process from the above-mentioned step S20.

As explained above, according to the printing system of this embodiment, the printer 10 detects the USB cable unplugged by the observation of the voltage on the VBUS, and the printer 10 clears the RAM 14 being the data buffer of the printer 10 when the USB cable is plugged. Therefore, it prevents the printer 10 from printing the unnecessary printing data PDAT remaining in the RAM 14 and performing meaningless printing.

In addition, as in the case of the above-mentioned first embodiment, in the printer 10 which has neither a power switch nor a control panel, the printing data PDAT can be cleared without unplugging and plugging the power cord 24. Therefore, the ease-of-use of the printer 10 can be improved.

#### (Third Embodiment)

In the above-mentioned second embodiment, the printer 10 is designed to clear the data buffer of the RAM 14 when the USB cable is removed regardless of whether the printer 10 is in the process of printing. In contrast with this, in the third embodiment of the invention, the printer 10 is designed to clear the data buffer of the RAM 14 only when the USB cable is removed while the printer 10 is in the process of printing. More detailed explanation is made below.

A hardware configuration of the printing system according to the third embodiment of the invention is similar to the above-mentioned second embodiment. That is, in the printing system shown in Fig. 1, the printer cable 50 connecting the printer 10 and the computer 30 is the USB cable.

Referring to Fig. 6, a printing data receiving processing

of the printer 10 is explained in detail. Fig. 6 is a flow chart for explaining the printing data receiving processing of the printer 10.

5 A program for the printing data receiving processing is stored in the ROM 16 of the printer 10. The power is supplied to the printer 10, and the CPU 12 reads out and runs this program so that the printing data receiving processing is performed.

10 First, as shown in Fig. 6, the printer 10 judges whether a magic string MS has been received from the computer 30 (step S30). When the magic string MS has not yet been received (step S30: No), the printer 10 is waiting by repeating step 30 since the computer 30 does not start to transmit the printing data PDAT.

15 On the other hand, when the printer 10 receives the magic string MS (step S30: Yes), the printer 10 acquires a voltage of the VBUS of the USB (step S31) since it means that the computer 30 starts to transmit the printing data PDAT. Subsequently, the printer 10 judges whether the voltage is approximately 5V (step S32).

20 When the voltage has not been approximately 5V (step S32: No), for instance, when the voltage has been dropped to about 0V, it means removing the printer cable 50 being USB so that the printer 10 clears the data buffer of the RAM 14 and initializes the interface (step S33). Then the printer 10 returns to the above-mentioned step 30.

25 On the other hand, when the voltage has been approximately 5V (step S32: Yes), it means the transmission of the printing data PDAT is started, so that the printer 10 judges whether the close channel CC is received (step S34). When the close channel CC has not been received (step S34: No), it means the transmission of the printing data PDAT is continued, so that the printer 10 continues to print (step S35). Then, the process from the above-mentioned step S31 is repeated.

35 On the other hand, when the close channel CC has been received (step S34: Yes), it means that the computer 30 has finished sending the printing data PDAT so that the process from the above-mentioned step S30 is repeated.

As explained above, according to the printing system of

this embodiment, as in the case of the above-mentioned second embodiment, the printer 10 detects the USB cable unplugged by the observation of the voltage of the VBUS, and the printer 10 clears the RAM 14 being the data buffer of the printer 10 when the USB cable is unplugged. Therefore, it prevents the printer 10 from printing the unnecessary printing data PDAT remaining in the RAM 14 and performing meaningless printing.

Moreover, in the printer 10 according to this embodiment, the printer 10 erases the printing data PDAT remaining in the data buffer of the RAM 14 only when the printer cable 50 being the USB is unplugged during a printing operation. Therefore, the printer 10 can prevent the possibility that data stored in the RAM 14 is erased carelessly.

In addition, as in the cases of the above-mentioned first and second embodiments, in the printer 10 which has neither a power switch nor a control panel, the printing data PDAT can be cleared without unplugging and plugging again the power cord 24. Therefore, the ease-of-use of the printer 10 can be improved.

#### (Fourth Embodiment)

According to the fourth embodiment of the invention, a printing system uses a technique of detecting the plugging and unplugging of the printer cable 50, which is different from the first embodiment. That is, the technique of detecting the plugging and unplugging is modified in the case of using the printer cable 50 which is a type that the plugging and unplugging of the cable cannot be physically detected. More detailed explanation is made below.

First, in accordance with Fig. 7, a configuration of logical channels formed between the printer 10 and the computer 30 for communication is explained. Fig. 7 is a schematic diagram for explaining the logical channel formed on a communication line.

As shown in Fig. 7, a control channel CNC, a printer control channel PCC and a printing data transfer channel DTC are formed between the printer 10 and computer 30 as the logical channels. The control channel CNC is for opening and/or closing the logical channel, and for transmitting information of the number of sent packets and the like. The printer control channel PCC is for

confirming the amount of remaining inks, transmitting a instruction of a ink change and the like. The printing data transfer channel DTC is for transmitting the printing data from the computer 30 to the printer 10.

5           In this embodiment, erasing the printing data PDAT stored in the RAM 14 is performed with the combined use of two techniques. Fig. 8 is a diagram for explaining one technique and Fig. 9 is a diagram for explaining the other technique. First, one technique is explained in accordance with Fig. 8.

10           Fig. 8 is a timing chart in the case where a printing is performed using the control channel CNC and the printing data transfer channel DTC. As shown in Fig. 8, the computer 30 transmits a cable plug/unplug effective command to the printer 10 by using the control channel CNC. Having received this command, the printer  
15   10 sets a monitoring effective flag. Next, the computer 30 transmits an open command for the printing data transfer channel DTC to the printer 10 by using the control channel CNC. As a result, the printing data transfer channel DTC between the printer 10 and computer 30 is opened.

20           Subsequently, the computer 30 transmits packets, which are formed by dividing the printing data, to the printer 10 by using the printing data transfer channel DTC. The printer 10, which received these packets, forms the printing data by restructuring these packets and performs a printing on the basis of the printing  
25   data.

          Having finished sending all the packets for the printing data, the computer 30 transmits a close command for the printing data transfer channel DTC by using the control channel CNC. As a result, the printing data transfer channel DTC between the printer  
30   10 and computer 30 is closed. Then, the computer 30 transmits a cable plug/unplug ineffective command to the printer 10 by using the control channel CNC. Having received this command, the printer 10 resets the monitoring effective flag.

          However, in the case where the printer cable 50 is unplugged  
35   from the printer 10 during a printing operation and plugged again into the printer 10, the printer 10 receives a device ID request before the printer 10 receives the cable plug/unplug ineffective

command. The reason for this is that, the computer 30 is designed to transmit a device ID request to the printer 10 when a user plugs the printer cable 50 again and restarts printing. That is, detecting the device ID request while the monitoring effective flag is set means that a printing data is to be sent again. Therefore, the printer 10 can detect that the printer cable 50 was unplugged and then plugged again.

Next, referring to Fig. 9, the other technique is explained. Fig. 9 is a timing chart in the case where printing data is transmitted by using the printing data transfer channel DTC. As shown in Fig. 9, the computer 30 transmits packets of the printing data to the printer 10 by using the printing data transfer channel DTC. In the printer 10, a packet receiving flag is set only while a packet is being received. That is, the flag is not set/reset in synchronism with open/close of the printing data transfer channel DTC, but in synchronism with the receiving/non-receiving of packet. When the device ID request is received during setting the packet receiving flag, the printer 10 is able to judge that the printer cable 50 is removed and inserted.

Next, referring to Fig. 10, the transmitting and receiving of signals between the printer 10 and computer 30 in the case where the printer cable 50 is unplugged in partway for a printing operation and plugged again.

As shown in Fig. 10, first, the computer 30 sends a device ID request DREQ to the printer 10. The printer 10, which receives the device ID request DREQ, sends a device ID reply DRPY to the computer 30.

Next, the computer 30 sends a cable plug/unplug effective command CEC to the printer 10. Subsequently, the computer 30 sends an open command POP for the printing data transfer channel DTC to the printer 10.

Next, the computer 30 sends printing data PDAT to the printer 10 packet by packet. The printer 10, which receives the packets, sends a busy signal BS to the computer 30 every time a packet is received. In this way, the printing data PDAT is sent from the computer 30 to the printer 10 while a transmission and reception of data is checked. The printer 10 generates image data on the

basis of the received data PDAT and performs printing in the printing executing section 22.

In the case where the printer cable 50 is removed due to user's error and the like, the communication line is disconnected in partway for a printing operation. Then, when it is recovered, the computer 30 is in a state of waiting for the busy signal BS being a response from the printer 10, and the printer 10 is in a state of waiting for the printing data PDAT from the computer 30. Furthermore, when the user gives instructions for a printing to the computer 30 again, the computer 30 transmits a device ID request DREQ to the printer 10.

However, for the printer 10, the printing data transfer channel DTC has already been open and the monitoring effective flag has already been set, so that the printer 10 is in a state of waiting for the printing data PDAT. Therefore, receiving the device ID request DREQ again means that the printer cable 50 has been removed and inserted again in a printing operation. Hence, the printer 10 clears the printing data PDAT remaining in the RAM 14, which is a data buffer, ejects printing paper which is stopped in partway for a printing operation, and resets itself to return an initial state.

Next, referring to Fig. 11, a processing of the computer 30 according to this embodiment is explained. Fig. 11 is a flow chart for explaining a printing data transfer processing of the host computer 30. For example, first, a user gives instructions for a printing to the computer 30 by using an application program for making documents, and the computer 30 generates a printing data PDAT in accordance with data inputted from the application program (step S40). Subsequently, the computer 30 generates packets in accordance with the printing data PDAT and transmits one of the packets to the printer 10 (step S41).

Next, the computer 30 judges whether a busy signal BS is received from the printer 10 (step S42). When the computer 30 has received the busy signal BS (step S42: Yes), the computer 30 judges whether all the packets generated from the printing data PDAT have been transmitted (step S43). When all the packets generated from the printing data PDAT have been transmitted (step

S43: Yes), this processing is ended. On the other hand, all the packets have not yet been transmitted (step S43: No), the computer 30 returns to step S41 mentioned above and repeats the transmission of the packets.

5           On the other hand, in the case where the printer cable 50 is unplugged and plugged, since the busy signal BS does not return from the printer 10, the computer 30 decides "No" in the above-mentioned step S42. Therefore, the computer 30 judges whether a predetermined time (for example, 20 seconds) has passed  
10 since the response from the printer 10 disconnected (step S44). When the predetermined time has not passed yet (step S44: No), the computer 30 returns to step S42 and monitors whether a response is received from the printer 10.

          On the other hand, when the computer 30 has not received  
15 the busy signal BS from the printer 10 even if the predetermined time has passed (step S44: Yes), the computer 30 asks the user whether the printing should be cancelled or retried (step S45). When the user has canceled the printing (step S45: Yes), the computer 30 discards the printing data (step S46). After that, the user  
20 provides the computer 30 with instructions for printing the same document as the last time or printing a document different from the last time (step S47). Then, the computer 30 returns to the above-mentioned step S40, generates the printing data again (step S40), and repeats the processing described above.

25           On the other hand, in step S45, when the user has chosen the retry for printing (step S45: No), the computer 30 returns to step S42 and waits for only the predetermined time for the busy signal BS from the printer 10.

          Next referring to Fig. 12, a processing of the printer 10  
30 according to this embodiment is explained. Fig. 12 is a flow chart for explaining a receiving processing of the printer 10.

          As shown in Fig. 12, the printer 10 judges whether unplugging and plugging the printer cable 50 is detected (step S50). When unplugging and plugging the printer cable 50 has been detected  
35 (step S50: Yes), the printer 10 clears the remaining printing data PDAT stored in the RAM 14, and ejects the paper in the course of the printing operation by a reset operation (step S51). By



the way, step S50 for judging cable plugging/unplugging and step S51 for the reset operation are explained with reference to Fig. 13 later.

On the other hand, when unplugging and plugging the printer cable 50 has not been detected (step S50: No), the printer 10 judges whether the printing data PDAT are received from the computer 30 (step S52). When the printing data PDAT has not been received (step S52: No), the processing from step S50 is repeated.

On the other hand, when the printing data PDAT has been received from the computer 30 (step S52: Yes), the printer 10 generates image data on the basis of the printing data PDAT (step S53) and performs printing (step S54). Then, the processing from step S50 is repeated.

Next referring to Fig. 13, the unplugging/plugging detecting process in step 50 of Fig. 12 and the reset process in step S51 are explained in detail. Fig. 13 is a flow chart for explaining the unplugging/plugging detecting process and the reset process in detail.

As shown in Fig. 13, first, the printer 10 judges whether the cable plug/unplug effective command is received (step S60). When the cable plug/unplug effective command has been received (step S60: Yes), the monitoring effective flag is set (step S61).

After the monitoring effective flag is set in step S61, or when the cable plug/unplug effective command has not been received (step S60: No), the printer 10 judges whether the cable plug/unplug ineffective command is received (step S62). When the cable plug/unplug ineffective command has been received (step S62: Yes), the monitoring effective flag is reset (step S63).

After the monitoring effective flag is reset in step S63, or when the cable plug/unplug ineffective command has not been received (step S62: No), the printer 10 judges whether the printer 10 is receiving any packet in the control channel CNC, printer control channel PCC or printing data transfer channel DTC (step S64). When the printer 10 is receiving the packet (step S64: Yes), the packet receiving flag is set (step S65), whereas when the printer 10 is not receiving the packet (step S64: No), the packet receiving flag is reset (step S66). A preparation for monitoring

the plugging/unplugging of the cable is finished by the above-explained steps.

Next, the printer 10 judges whether a device ID request DREQ is received in a state that the monitoring effective flag is set (step S67). When the device ID request DREQ has not been received in a state that the monitoring effective flag is set (step S67: No), the printer 10 judges whether the device ID request DREQ is received in a state that the packet receiving flag is set (step S68).

10 When the device ID request DREQ has been received in a state that the monitoring effective flag is set (step S67: Yes), or when the device ID request DREQ has been received in a state that the packet receiving flag is set (step S68: Yes), a plug/unplug detecting flag, which indicates whether the printer cable 50 is unplugged and plugged, is set (step S69). On the other hand, when the device ID request DREQ has not been received in a state that the monitoring effective flag is set (step S67: No), and when the device ID request DREQ has been received in a state that the packet receiving flag is set (step S68: No), the plug/unplug detecting flag is reset (step S70).

Next, the printer 10 transmits a device ID reply to the computer 30 in response to the device ID request DREQ (step S71). Subsequently, the printer 10 judges whether the plug/unplug detecting flag is set (step S72). When the plug/unplug detecting flag has not been set (step S72: No), the printer 10 returns to step S60 mentioned above.

On the other hand, when the plug/unplug detecting flag has been set (step S72: Yes), the printer 10 clears the printing data PDAT remaining in the data buffer which is formed in the RAM 14 (step S73). Then, the printer 10 ejects the paper stopped in printing operation (step S74) and initializes the interface to prepare for the next printing (step S75). Then, the printer 10 returns to step S60 mentioned above.

As explained above, as in the case of the above-mentioned first embodiment, the printing system according to this embodiment can avoid doing an unnecessary print when the printer cable 50 is unplugged during a printing operation, even if the printer

cable 50 is a parallel cable, an unplugging state of which is not able to be directly detected it unplugging.

In addition, in the printer 10 which has neither a power switch nor a control panel, the rest of the printing data PDAT  
5 can be cleared without unplugging and plugging again the power cord 24. Therefore, ease-of-use of the printer 10 can be improved.

Furthermore, since a reset operation can be performed even when the device ID request DREQ is received while a packet is being received, this reset operation can be performed even when  
10 the connector of the printer cable 50 is removed and then inserted at the timing other than the timing for printing.

(Fifth Embodiment)

According to the fifth embodiment of the invention, the fourth embodiment is modified so that the printer judges whether  
15 the printer cable 50 is unplugged and plugged by not using the packet receiving flag but using only the monitoring effective flag.

Fig. 14 is a flow chart for explaining plug/unplug detecting process in step S50 and a reset process in step S51 according  
20 to this embodiment. Fig. 14 corresponds to Fig. 13 in the fourth embodiment.

In this embodiment, plugging and unplugging of the printer cable 50 is managed by using only the monitoring effective flag. That is, the printer 10 sets the monitoring effective flag when  
25 the cable plug/unplug effective command is received from the computer 30 whereas the printer 10 resets the monitoring effective flag when the cable plug/unplug ineffective command is received from the computer 30. Then, when the printer 10 receives the device ID request DREQ while the monitoring effective flag is set, the  
30 printer 10 presumes that the printer cable 50 is unplugged and then plugged again during a printing operation and erases the rest of the printing data PDAT in RAM 14.

As a result, as shown in Fig. 14, in this embodiment, steps S64 to S66 and step S69 are omitted from the fourth embodiment  
35 (Fig. 13). Since this embodiment is similar to the above-mentioned fourth embodiment except this point, an explanation in detail is omitted.

As explained above, according to this embodiment, the printer 10 detects unplugging and plugging the cable by using only the monitoring effective flag, so that the printer 10 can monitor the unplugging and plugging of the printer cable 50 only while the computer 30 is transmitting the printing data PDAT to the printer 10. Therefore, it is possible to prevent the printer 10 from unnecessarily erasing the printing data PDAT stored in the RAM 14.

The invention is not limited to the embodiments explained above, but various changes or modifications are possible. For example, the invention can be applied to a printer having a power switch and/or a control panel. A connecting specification between the printer 10 and computer 30 is not limited to the parallel cable or the USB explained above, but other connecting specification can be employed.

Further, in the first and third embodiments, the magic string MS or the device ID request DREQ is a print start signal indicating a start of the transmission of the printing data PDAT, and the close channel CC is a print finish signal indicating a finish of the transmission of the printing data PDAT, but other signal can be employed.

In addition, in the fourth and fifth embodiments, the cable plug/unplug effective command is the print start signal, and the cable plug/unplug ineffective command is a print finish signal indicating a finish of the transmission of the printing data PDAT, but other signal can be employed. For example, the open command for printing data transfer channel is employed as the print start signal and the close command for printing data transfer channel is employed as the print finish signal.

Further, in the respective processing explained with the foregoing embodiments, the programs for executing these processing can be distributed in a form of a recording medium such as CD-ROM (compact disc read only memory), ROM or memory card, for example. In this case, once the printer 10 and/or the computer 30 read the programs from such a recording medium and execute the programs, the embodiment explained above can be realized.

In many cases, the printer 10 and/or the computer 30 have other programs such as operating system, other application programs, and so on. In these cases, the programs owned by the printer 10 and/or the computer 30 may be efficiently used, and instructions for calling programs from the own programs of the printer 10 and/or the computer 30, which realize processing equivalent to the processing of the foregoing embodiments, may be recorded on the recording medium.

These programs may also be distributed as carrier waves through a network, instead of the form of a recording medium. The programs, transmitted as carrier waves through a network, are stored in the printer 10 and/or the computer 30 and can be executed to realize the foregoing embodiments.

In some cases, the program is encrypted and/or compressed when it is recorded on a recording medium or transmitted as carrier waves through a network. In these cases, the printer 10 and/or the computer 30, having read the program from the recording medium or carrier waves, has to decode and/or expand the programs before executing it.

As described above, according to the invention, the printer detects that the printer cable is unplugged and plugged again, and clears the printing data remaining in the data buffer, so that it is possible to prevent the printer from performing unnecessary printing.

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